

Appendix B

Radiological Calculation Methods

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A variety of radiological calculations are required to determine whether a waste can be stored at the INEEL SSA. The following sections describe the methodology for performing these calculations. For each calculation, the following assumptions shall be used:

- All major radionuclides in the waste, as defined in Section 2.3.1, must be considered in the calculations. If there is a major radionuclide in the waste that is not listed in Tables B-1 and B-2 (which will be modified as necessary), the generator must notify the SSA to calculate the applicable limits and conversion factors.
- If a daughter radionuclide has a half-life less than 10 days and the parent radionuclide has a half-life greater than the daughter, the activity of the daughter should not be considered in the calculations.
- Except for the NRC Class C calculation, the volume of the waste in each container should be used when limits are expressed in volume concentration (Section B.6 presents information regarding the Class C calculations).

B.1 Transuranic Waste Determination

Transuranic waste is radioactive waste containing more than 100 nanocuries (3700 becquerels) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for:

- High-level radioactive waste
- Waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations.

B.2 Calculation of Plutonium Equivalents

PU-239 equivalent activity of the following individual waste packages is in accordance with WIPP WAC (INEEL RCRA Permit):

- 5-gallon drums, 80 curies equivalent
- Standard waste box, 130 curies equivalent
- Standard waste box, \leq 1800 curies equivalent
- Solidified/vitrified waste, \leq 1800 curies equivalent
- INEEL Wood Boxes, measuring $2 \times 4 \times 8$ ft.
- INEEL Wood Boxes, measuring $4 \times 4 \times 4$ ft
- INEEL Wood Boxes, measuring $4 \times 4 \times 8$ ft.

B.3 Calculation of Thermal Power

The thermal power of the waste in a container is calculated from the concentration of radionuclides in the waste and the heat of decay from Table B-1. The thermal power calculation is performed in the following steps:

1. The concentration of each radionuclide (expressed in curies per cubic meter) is multiplied by the heat of decay for that nuclide from Table B-1, yielding the heat of decay for each in units of watts per cubic meter.
2. Thermal power is the sum of the heat of decay of all radionuclides in the waste.

B.4 Category 1 Determination

Classification of waste as Category 1 or greater than Category 1 is a sum of fractions calculation, performed in the following steps:

1. The concentration of each nuclide (expressed in curies per cubic meter) is divided by its respective Category 1 limit (Table B-2).
2. The resulting values are added to form the sum of fractions.
3. If the sum of fractions is less than or equal to 1, the waste is Category 1. If the sum of fractions exceeds 1, the waste is greater than Category 1, and the Category 3 determination must be performed to classify the waste.

B.5 Category 3 Determination

Category 3 determination is performed in the same way as the Category 1 calculation, except that the Category 3 limits from Table B-2 are used as follows:

1. The concentration of each nuclide (expressed in curies per cubic meter) is divided by its respective Category 3 limit from Table B-2
2. The resulting values are added to form a sum of fractions
3. If the sum of fractions is less than or equal to 1, the waste is Category 3. If the sum of fractions exceeds 1, the waste is greater than Category 3.

B.6 Class C Determination

Class C determination shall be performed as specified in 10 CFR 61.55.

B.7 Interim Safety Basis Calculations For Low-Level Storage

The ISB calculations are performed in the following steps:

1. Determine the appropriate set of limits from Table B-2 (i.e., noncombustible containerized waste or combustible containerized waste)

2. Divide the concentration of each radionuclide by its respective limit
3. Add the resulting values to form a sum of fractions.

If the sum of fractions is less than or equal to 1, the waste lies within the ISB limits. If combustible waste exceeds the combustible waste limit, but does not exceed the noncombustible waste limit, the SSA acceptance organization can perform an evaluation to determine whether segregation or stabilization can be used to mitigate the combustibility hazard. The SSA will not accept noncombustible waste if the noncombustible waste limit is exceeded.

B.8. Mobile Radionuclide Reporting

This is a simple comparison of the concentration of each mobile radionuclide (^3H , ^{14}C , ^{36}Cl , ^{79}Se , ^{93}Mo , ^{99}Tc , ^{129}I , ^{187}Re , Total U, and ^{237}Np) against its respective reporting value from Table B-2.

B.9. Calculating Dose-Equivalent Curies

Calculation of Dose Equivalent-Curies (DE-Ci) is a method of normalizing the exposure risk of various radionuclides. DE-Ci limits are established for certain TSD units as part of the safety basis. Calculation of the DE-Ci of a waste container is performed in the following steps:

1. Multiply the activity (in Ci) of each isotope in a given container by its respective DE-Ci correction factor from Table B-1.
2. Add the resulting values to obtain the total DE-Ci of the package.

Table B-1. Conversion factors for general radiological calculations.

Isotope	Half-life (days)	Specific activity (curies per gram)	Heat of decay (watts per curie)	Dose equivalent curie correction factor
^3H	4.5034 E+03	9.66 E+03	3.38 E-05	1.49 E-07
^7Be	5.3920 E+01	3.50 E+05	2.94 E-04	7.47 E-07
^{10}Be	5.8439 E+08	2.23 E-02	1.20 E-03	8.25 E-04
^{14}C	2.0928 E+06	4.46 E+00	2.93 E-04	4.86 E-06
^{22}Na	9.5032 E+02	6.25 E+03	8.71 E-03	1.78 E-05
^{32}P	1.4262 E+01	2.86 E+05	4.21 E-03	3.61 E-05
^{35}S	8.7510 E+01	4.26 E+04	2.88 E-04	5.76 E-06
^{36}Cl	1.0994 E+08	3.30 E-02	1.43 E-03	5.11 E-05
^{40}K	4.6641 E+11	7.00 E-06	3.33 E-03	2.87 E-05
^{45}Ca	1.6380 E+02	1.77 E+04	4.56 E-04	1.54 E-05
^{46}Sc	8.3790 E+01	3.39 E+04	1.26 E-02	6.90 E-05
^{49}V	3.3000 E+02	8.08 E+03	5.16 E-06	8.04 E-07
^{51}Cr	2.7702 E+01	9.24 E+04	1.93 E-04	7.78 E-07
^{54}Mn	3.1210 E+02	7.75 E+03	4.96 E-03	1.56 E-05

Table B-1. (continued).

Isotope	Half-life (days)	Specific activity (curies per gram)	Heat of decay (watts per curie)	Dose equivalent curie correction factor
⁵⁵ Fe	9.9711 E+02	2.38 E+03	9.66 E-06	6.25 E-05
⁵⁶ Co	7.7270 E+01	3.02 E+04	2.02 E-02	9.22 E-05
⁵⁷ Co	2.7179 E+02	8.43 E+03	7.42 E-04	2.11 E-05
⁵⁸ Co	7.0820 E+01	3.12 E+04	4.91 E-03	2.53 E-05
⁵⁹ Fe	4.4503 E+01	4.97 E+04	7.74 E-03	3.44 E-05
⁵⁹ Ni	2.7758 E+07	7.97 E-02	1.36 E-05	3.08 E-06
⁶⁰ Co	1.9253 E+03	1.13 E+03	1.54 E-02	5.09 E-04
⁶³ Ni	3.6561 E+04	5.67 E+01	1.01 E-04	7.23 E-06
⁶⁵ Zn	2.4426 E+02	8.22 E+03	3.38 E-03	4.75 E-05
⁶⁸ Ge	2.7082 E+02	7.09 E+03	2.44 E-05	1.20 E-04
⁷⁵ Se	1.1978 E+02	1.45 E+04	2.32 E-03	1.97 E-05
⁷⁹ Se	2.3741 E+07	6.96 E-02	3.14 E-04	2.29 E-05
⁸² Sr	2.5550 E+01	6.23 E+04	4.65 E-05	1.43 E-04
⁸⁵ Kr	3.9285 E+03	3.91 E+02	1.50 E-03	1.64 E-14
⁸⁵ Sr	6.4840 E+01	2.37 E+04	3.07 E-03	1.17 E-05
⁸⁶ Rb	1.8631 E+01	8.15 E+04	4.51 E-03	1.54 E-05
⁸⁸ Y	1.0665 E+02	1.39 E+04	1.59 E-02	6.54 E-05
⁸⁹ Sr	5.0530 E+01	2.90E+04	3.46 E-03	9.65 E-05
⁹⁰ Sr- ⁹⁰ Y*	1.0512 E+04	2.76 E+02	5.54 E-03	3.04E-03
⁹³ Mo	1.4610 E+06	9.61 E-01	7.41 E-05	6.62 E-05
^{93m} Nb	5.8914 E+03	2.38 E+02	1.09 E-05	6.81 E-05
⁹³ Zr	5.5882 E+08	2.51 E-03	1.24 E-04	7.74 E-04
⁹⁴ Nb	7.4144 E+06	1.87 E-01	1.02 E-02	9.65 E-04
⁹⁵ Nb	3.4975 E+01	3.93 E+05	4.68 E-03	1.35 E-05
⁹⁵ Zr- ^{95m} Nb*	6.4020 E+01	4.42 E+04	4.24 E-04	6.09 E-05
⁹⁹ Tc	7.7103 E+07	1.71 E-02	5.04 E-04	1.93 E-05
¹⁰³ Ru- ^{103m} Rh*	3.6260 E+01	7.00 E+04	3.36 E-03	2.08 E-05
¹⁰⁶ Ru- ¹⁰⁶ Rh*	3.7359 E+02	6.59 E+03	3.99 E-04	1.11E-03
¹⁰⁷ Pd	2.3741 E+09	5.14 E-04	5.51 E-05	2.97 E-05
^{108m} Ag	4.6386 E+04	2.61 E+01	9.96 E-03	6.60 E-04
¹⁰⁹ Cd	4.6260 E+02	2.59 E+03	1.54 E-04	2.66 E-04
^{110m} Ag- ¹¹⁰ Ag*	2.4979 E+02	9.50 E+03	7.19 E-03	1.87 E-04
^{113m} Cd	5.1499 E+03	2.24 E+02	1.08 E-03	3.56 E-03
¹¹³ Sn	1.1509 E+02	1.00 E+04	1.66 E-03	2.48 E-05
^{119m} Sn	2.9310 E+02	3.74 E+03	6.78 E-05	1.45 E-05

Table B-1. (continued).

Isotope	Half-life (days)	Specific activity (curies per gram)	Heat of decay (watts per curie)	Dose equivalent curie correction factor
^{121m} Sn	2.0088 E+04	5.37 E+01	6.59 E-05	2.68 E-05
¹²¹ Te	1.6780 E+01	6.43 E+04	3.42 E-03	4.43 E-06
¹²³ Te	3.6524 E+15	2.91 E-10	1.29 E-03	2.45 E-05
¹²⁴ Sb	6.0200 E+01	1.75 E+04	1.33 E-02	5.86 E-05
¹²⁵ I	5.9408 E+01	1.76 E+04	2.51 E-04	5.62 E-05
¹²⁵ Sb	1.0074 E+03	1.04 E+03	3.14 E-03	2.84 E-05
^{125m} Te	5.7400 E+01	1.82 E+04	2.13 E-04	1.69 E-05
¹²⁶ Sb	1.2460 E+01	8.32 E+04	1.83 E-02	2.73 E-05
¹²⁶ Sn- ^{126m} Sb*	3.6524 E+07	5.68 E+02	1.23 E-02	2.31 E-04
^{127m} Te- ¹²⁷ Te*	1.0900 E+02	1.86 E+04	1.36 E-03	5.07 E-05
¹²⁹ I	5.7343 E+09	1.77 E-04	3.93 E-04	4.04 E-04
^{129m} Te	3.3600 E+01	3.01 E+04	1.44 E-03	5.57 E-05
^{131m} Xc	1.1840 E+01	8.42 E+04	1.19 E-04	6.07 E-12
¹³³ Ba	3.8423 E+03	2.56 E+02	2.39 E-03	1.81 E-05
¹³⁴ Cs	7.5313 E+02	1.29 E+03	1.02 E-02	1.08 E-04
¹³⁵ Cs	8.4006 E+08	1.15 E-03	3.32 E-04	1.06 E-05
¹³⁷ Cs- ^{137m} Ba*	1.0983 E+04	1.69 E+02	3.36 E-03	7.44 E-05
¹⁴⁰ Ba	1.2752 E+01	7.31 E+04	2.72 E-03	8.70 E-06
¹⁴¹ Ce	3.2501 E+01	2.85 E+04	8.60 E-04	2.80 E-05
¹⁴⁴ Ce- ¹⁴⁴ Pr*	2.8489 E+02	6.37 E+03	7.34 E-03	8.70 E-04
¹⁴⁷ Nd	1.0980 E+01	8.09 E+04	2.22 E-03	1.59 E-05
¹⁴⁷ Pm	9.5818 E+02	9.27 E+02	3.68 E-04	9.13 E-05
¹⁴⁷ Sm	3.8716 E+13	2.29 E-08	1.37 E-02	1.74 E-01
¹⁵⁰ Eu	1.3076 E+04	6.66 E+01	8.90 E-03	6.25 E-04
¹⁵¹ Sm	3.2872 E+04	2.63 E+01	7.41 E-04	6.98 E-05
¹⁵² Eu	4.9461 E+03	1.74 E+02	7.03 E-03	5.14 E-04
¹⁵² Gd	3.9446 E+16	2.18 E-11	1.31 E-02	5.67 E-01
¹⁵³ Gd	2.4160 E+02	3.53 E+03	6.03 E-04	5.54 E-05
¹⁵⁴ Eu	3.1385 E+03	2.70 E+02	8.77 E-03	6.66 E-04
¹⁵⁵ Eu	1.7390 E+03	4.84 E+02	6.53 E-04	9.65 E-05
¹⁷⁰ Tm	1.2860 E+02	5.97 E+03	1.90 E-03	6.12 E-05
¹⁷⁵ Hf	7.0000 E+01	1.07 E+04	2.16 E-03	1.30 E-05
¹⁸¹ Hf	4.2390 E+01	1.70 E+04	3.85 E-03	3.59 E-05
¹⁸² Ta	1.1443 E+02	6.27 E+03	8.46 E-03	1.04 E-04
¹⁸⁵ W	7.5100 E+01	9.40 E+03	7.53 E-04	1.75 E-06

Table B-1. (continued).

Isotope	Half-life (days)	Specific activity (curies per gram)	Heat of decay (watts per curie)	Dose equivalent curie correction factor
¹⁸⁷ Re	1.5888 E+13	4.39 E+08	3.91 E-06	1.26 E-07
¹⁹⁵ Au	1.8609 E+02	3.60 E+03	5.10 E-04	3.01 E-05
²⁰³ Hg	4.6612 E+01	1.38 E+04	1.75 E-03	1.70 E-05
²⁰⁴ Tl	1.3806 E+03	4.64 E+02	1.38 E-03	5.60 E-06
²⁰⁷ Bi	1.1523 E+04	5.47 E+01	9.12 E-03	4.66 E-05
²¹⁰ Pb	8.1449 E+03	7.63 E+01	6.62 E-05	3.16 E-02
²¹⁰ Po	1.3838 E+02	4.49 E+03	3.26 E-02	2.18 E-02
²²⁶ Ra	5.8439 E+05	9.89 E+01	2.89 E-02	2.00 E-02
²²⁷ Ac	7.9524 E+03	7.23 E+01	1.46 E-03	4.00 E+00
²²⁸ Ra	2.1001 E+03	2.73 E+02	2.71 E-04	1.11 E-02
²²⁸ Th	6.9874 E+02	8.20 E+02	3.27 E-02	7.95 E-01
²²⁹ Th	2.6809 E+06	2.13 E-01	3.08 E-02	5.00 E+00
²³⁰ Th	2.7532 E+07	2.06 E-02	2.83 E-02	7.58 E-01
²³¹ Pa	1.1965 E+07	4.72 E-02	3.08 E-02	2.99 E+00
²³² Th	5.1317 E+12	1.10 E-07	2.42 E-02	3.81 E+00
²³² U	2.5165 E+04	2.24 E+01	3.21 E-02	1.53 E+00
²³³ U	5.8147 E+07	9.64 E-03	2.91 E-02	3.15 E-01
²³⁴ Th	2.4100 E+01	2.32 E+04	1.49 E-04	8.16 E-05
²³⁴ U	8.9667 E+07	6.26 E-043	2.88 E-02	3.08 E-01
²³⁵ U	2.5706 E+11	2.16 E-06	2.86 E-02	2.86 E-01
²³⁶ Pu	1.0439 E+03	5.30 E+02	3.48 E-02	3.37 E-01
²³⁶ U	8.5540 E+09	6.47 E-05	2.71 E-02	2.92 E-01
²³⁷ Np	7.8162 E+08	7.05 E-04	2.96 E-02	1.25 E+00
²³⁸ Pu	3.2032 E+04	1.71 E+01	3.31 E-02	9.13 E-01
²³⁸ U	1.6319 E+12	3.36 E-07	2.53 E-02	2.75 E-01
²³⁹ Pu	8.8060 E+06	6.21 E-02	3.11 E-02	1.00 E+00
²⁴⁰ Pu	2.3971 E+06	2.28 E-01	3.10 E-02	1.00 E+00
²⁴¹ Am	1.5786 E+05	3.44 E+00	3.33 E-02	1.03 E+00
²⁴¹ Pu	5.2412 E+03	1.03 E+02	3.30 E-05	1.92 E-02
^{242m} Am	5.1499 E+04	1.05 E+01	2.37 E-04	9.91 E-01
²⁴² Cm	1.6280 E+02	3.31 E+03	3.68 E-02	4.02 E-02
²⁴² Pu	1.3634 E+08	3.96 E-03	2.93 E-02	9.56 E-01
²⁴³ Am	2.6918 E+06	2.00 E-01	3.22 E-02	1.02 E+00
²⁴³ Cm	1.0629 E+04	5.16 E+01	3.73 E-02	7.15 E-01
²⁴⁴ Cm	6.6109 E+03	8.09 E+01	3.50 E-02	5.77 E-01

Table B-1. (continued).

Isotope	Half-life (days)	Specific activity (curies per gram)	Heat of decay (watts per curie)	Dose equivalent curie correction factor
^{244}Pu	2.9512 E+10	1.83 E-05	2.77 E-02	9.39 E-01
^{245}Cm	3.1046 E+06	1.72 E-01	3.40 E-02	1.06 E+00
^{246}Cm	1.7276 E+06	3.07 E-01	3.25 E-02	1.05 E+00
^{247}Bk	5.0403 E+05	1.05 E+00	3.56 E-02	1.34 E+00
^{247}Cm	5.6978 E+09	9.29 E-05	3.36 E-02	9.65 E-01
^{248}Cm	1.2418 E+08	4.24 E-03	3.06 E-02	3.85 E+00
^{249}Cf	1.2820 E+05	4.09 E+00	3.93 E-02	1.34 E+00
^{250}Cf	4.7774 E+03	1.09 E+02	3.63 E-02	6.10 E-01
^{250}Cm	3.2872 E+06	2.07 E-01	2.19 E-04	2.18 E+01
^{251}Cf	3.2799 E+05	1.59 E+00	3.74 E-02	1.37 E+00
^{252}Cf	9.6607 E+02	5.38 E+02	3.69 E-02	3.65 E-01
^{254}Es	2.7570 E+02	1.86 E+03	3.92 E-02	9.56 E-02

* When this parent-daughter pair are in secular equilibrium, only the activity of the parent nuclide should be considered in performing the calculations. E.g., if $^{90}\text{Sr}-^{90}\text{Y}$ are in secular equilibrium in the waste, the thermal power for both nuclides would be determined by multiplying the ^{90}Sr activity by the heat of the decay for the $^{90}\text{Sr}-^{90}\text{Y}$ pair.

Table B-2. Low-level radiological content limits.

Isotope	Mobile Radionuclide Reporting Limit (Ci/m ³)	Category 1 Waste Limit (Ci/m ³)	Category 3 Waste Limit (Ci/m ³)	ISB Noncombustible Waste Limit ^a (Ci/m ³)	ISB Combustible Waste Limit ^b (Ci/m ³)
³ H	4.4 E+00	9.9 E+04	NL	4.00 E+07	5.00 E+02
⁷ Be	NL	NL	NL	2.64 E+07	6.59 E+05
¹⁰ Be	NL	1.1 E+00	2.4 E+02	1.00 E+04	2.50 E+02
¹⁴ C	1.3 E-04	9.1 E-02	2.1 E+01	1.76 E+06	4.41 E+04
¹⁴ C act. metal ^c	1.3 E-04	9.1 E-01	2.1 E+02	1.76 E+06	4.41 E+04
²² Na	NL	NL	NL	4.29 E+05	1.07 E+04
³² P	NL	NL	NL	2.31 E+05	5.77 E+03
³⁵ S	NL	NL	NL	1.46 E+06	3.66 E+04
³⁶ Cl	3.1 E-05	6.4 E-05	1.4 E-01	1.70 E+05	4.17 E+03
⁴⁰ K	NL	1.8 E-03	3.8 E-01	3.00 E+05	7.50 E+03
⁴⁵ Ca	NL	NL	NL	5.45 E+05	1.36 E+04
⁴⁶ Sc	NL	NL	NL	1.22 E+05	3.06 E+03
⁴⁹ V	NL	NL	NL	1.05 E+07	2.63 E+05
⁵¹ Cr	NL	NL	NL	1.00 E+07	2.50 E+05
⁵⁴ Mn	NL	NL	NL	5.22 E+05	1.30 E+04
⁵⁵ Fe	NL	NL	NL	1.33 E+06	3.33 E+04
⁵⁶ Co	NL	NL	NL	9.16 E+04	2.29 E+03
⁵⁷ Co	NL	NL	NL	4.29 E+05	1.07 E+04
⁵⁸ Co	NL	NL	NL	3.24 E+05	8.11 E+03
⁵⁹ Fe	NL	NL	NL	2.35 E+05	5.88 E+03
⁵⁹ Ni	NL	3.9 E+00	8.5 E+02	2.86 E+06	7.14 E+04
⁵⁹ Ni act. metal ^c	NL	3.9 E+01	8.5 E+03	2.86 E+06	7.14 E+04
⁶⁰ Co	NL	7.5 E+01	NL	1.82 E+04	4.55 E+02
⁶⁰ Co act. metal ^c	NL	7.5 E+02	NL	1.82 E+04	4.55 E+02
⁶³ Ni	NL	5.9 E+00	2.0 E+04	1.20 E+06	3.00 E+04
⁶³ Ni act. metal ^c	NL	5.9 E+01	2.0 E+05	1.20 E+06	3.00 E+04
⁶⁵ Zn	NL	NL	NL	1.97 E+05	4.92 E+03
⁶⁸ Ge	NL	NL	NL	7.02 E+04	1.75 E+03
⁷⁵ Se	NL	NL	NL	4.29 E+05	1.07 E+04
⁷⁹ Se	3.4 E-05	5.1 E-01	1.1 E+02	3.87 E+05	9.68 E+03
⁸² Sr	NL	NL	NL	5.91 E+04	1.48 E+03
⁸⁵ Kr	NL	NL	NL	2.11 E+09	2.63 E+04
⁸⁵ Sr	NL	NL	NL	1.97 E+06	4.92 E+04
⁸⁶ Rb	NL	NL	NL	5.45 E+05	1.36 E+04

Table B-2. (continued).

Isotope	Mobile Radionuclide Reporting Limit (Ci/m ³)	Category 1 Waste Limit (Ci/m ³)	Category 3 Waste Limit (Ci/m ³)	ISB Noncombustible Waste Limit ^a (Ci/m ³)	ISB Combustible Waste Limit ^b (Ci/m ³)
⁸⁸ Y	NL	NL	NL	1.29 E+05	3.24 E+03
⁸⁹ Sr	NL	NL	NL	6.67 E+05	1.67 E+04
⁹⁰ Sr- ⁹⁰ Y	NL	1.6 E-02	5.4 E+04	1.50 E+04	3.75 E+02
⁹³ Mo	2.1 E-04	8.7 E-01	2.0 E+02	1.28 E+05	3.19 E+03
^{93m} Nb	NL	NL	NL	1.21 E+05	3.03 E+03
⁹³ Zr	NL	2.50 E+00	5.40 E+02	4.62 E+03	1.15 E+02
⁹⁴ Nb	NL	2.2 E-04	4.8 E-02	9.23 E+03	2.31 E+02
⁹⁴ Nb act. ^c	NL	2.2 E-03	4.8 E-01	9.23 E+03	2.31 E+02
⁹⁵ Nb	NL	NL	NL	5.71 E+05	1.43 E+04
⁹⁵ Zr- ^{95m} Nb	NL	NL	NL	9.23 E+04	2.31 E+03
⁹⁹ Tc	2.1 E-04	2.3 E-02	5.0 E+00	4.00 E+05	1.00 E+04
¹⁰³ Ru- ^{103m} Rh	NL	NL	NL	3.87 E+05	9.68 E+03
¹⁰⁶ Ru- ¹⁰⁶ Rh	NL	NL	NL	8.00 E+03	2.00 E+02
¹⁰⁷ Pd	NL	1.5 E+01	3.3 E+03	2.86 E+05	7.14 E+03
^{108m} Ag	NL	NL	NL	2.15 E+04	5.39 E+02
¹⁰⁹ Cd	NL	NL	NL	2.45 E+04	6.12 E+02
^{110m} Ag- ¹¹⁰ Ag	NL	NL	NL	1.00 E+04	2.50 E+02
^{113m} Cd	NL	7.6 E-01	NL	1.79 E+03	4.48 E+01
¹¹³ Sn	NL	NL	NL	3.24 E+05	8.11 E+03
^{119m} Sn	NL	NL	NL	6.00 E+05	1.50 E+04
^{121m} Sn	NL	6.7 E-01	2.2 E+04	3.08 E+05	7.69 E+03
¹²¹ Te	NL	NL	NL	1.91 E+06	4.77 E+04
¹²³ Te	NL	NL	NL	1.38 E+05	3.44 E+03
¹²⁴ Sb	NL	NL	NL	1.38 E+05	3.45 E+03
¹²⁵ I	NL	NL	NL	5.00 E+04	1.25 E+00
¹²⁶ Sn- ^{126m} Sb	NL	1.6 E-04	3.4 E-02	3.64 E+04	9.09 E+02
^{125m} Te	NL	NL	NL	2.18 E+06	5.45 E+04
¹²⁵ Sb	NL	NL	NL	2.79 E+05	6.98 E+03
^{127m} Te- ¹²⁷ Te	NL	NL	NL	1.67 E+05	4.17 E+03
¹²⁹ I	1.0 E-06	8.5 E-03	1.8 E+00	7.06 E+03	1.76 E-01
^{129m} Te	NL	NL	NL	1.56 E+05	3.90 E+03
^{131m} Xe	NL	NL	NL	7.50 E+08	9.38 E+03
¹³³ Ba	NL	7.1 E-01	NL	4.62 E+05	1.15 E+04
¹³⁴ Cs	NL	NL	NL	8.57 E+04	2.14 E+03

Table B-2. (continued).

Isotope	Mobile Radionuclide Reporting Limit (Ci/m ³)	Category 1 Waste Limit (Ci/m ³)	Category 3 Waste Limit (Ci/m ³)	ISB Noncombustible Waste Limit ^a (Ci/m ³)	ISB Combustible Waste Limit ^b (Ci/m ³)
¹³⁵ Cs	NL	1.6 E-01	3.5 E+01	8.03 E+05	2.00 E+04
¹³⁷ Cs– ^{137m} Ba	NL	5.5 E-03	1.2 E+04	1.20 E+05	3.00 E+03
¹⁴⁰ Ba	NL	NL	NL	3.87 E+05	9.68 E+03
¹⁴¹ Ce	NL	NL	NL	4.14 E+05	1.03 E+04
¹⁴⁴ Ce– ¹⁴⁴ Pr	NL	NL	NL	1.00 E+04	2.50 E+02
¹⁴⁷ Nd	NL	NL	NL	5.45 E+05	1.36 E+04
¹⁴⁷ Pm	NL	NL	NL	9.23 E+04	2.31 E+03
¹⁴⁷ Sm	NL	1.7 E-02	3.7 E+00	2.86 E+01	7.14 E-01
¹⁵⁰ Eu	NL	1.4 E-03	6.7 E+02	1.38 E+04	3.45 E+02
¹⁵¹ Sm	NL	4.6 E+01	2.1 E+05	7.06 E+04	1.76 E+03
¹⁵² Eu	NL	4.8 E-02	NL	1.74 E+04	4.35 E+02
¹⁵² Gd	NL	6.4 E-03	1.4 E+00	3.64 E+00	9.09 E-02
¹⁵³ Gd	NL	NL	NL	1.09 E+05	2.73 E+03
¹⁵⁴ Eu	NL	7.5 E-01	NL	1.32 E+04	3.30 E+02
¹⁵⁵ Eu	NL	NL	NL	6.67 E+04	1.67 E+03
¹⁷⁰ Tm	NL	NL	NL	1.38 E+05	3.46 E+03
¹⁷⁵ Hf	NL	NL	NL	6.52 E+05	1.63 E+04
¹⁸¹ Hf	NL	NL	NL	1.23 E+05	3.07 E+03
¹⁸² Ta	NL	NL	NL	8.00 E+04	2.00 E+03
¹⁸⁵ W	NL	NL	NL	4.62 E+06	1.15 E+05
¹⁸⁷ Re	3.3 E-02	3.6 E+01	7.8 E+03	6.32 E+07	1.58 E+06
¹⁹⁵ Au	NL	NL	NL	2.81 E+05	7.03 E+03
²⁰³ Hg	NL	NL	NL	5.00 E+05	1.25 E+04
²⁰⁴ Tl	NL	NL	NL	1.51 E+06	3.78 E+04
²⁰⁷ Bi	NL	TBD	TBD	1.82 E+05	4.54 E+03
²¹⁰ Pb	NL	3.7 E-02	2.1 E+06	1.82 E+02	4.55 E+00
²¹⁰ Po	NL	NL	NL	1.82 E+02	4.55 E+00
²²⁶ Ra	NL	1.7 E-04	4.3 E-02	4.44 E+02	1.11 E+01
²²⁷ Ac	NL	4.2 E-03	3.0 E+05	3.08 E-01	7.69 E-03
²²⁸ Ra	NL	1.7 E+01	NL	8.57 E+02	2.14 E+01
²²⁸ Th	NL	NL	NL	7.06 E+00	1.76 E-01
²²⁹ Th	NL	4.4 E-04	9.8 E-02	7.06 E-01	1.76 E-02
²³⁰ Th	NL	2.1 E-03	1.5 E-01	4.62 E+00	1.15 E-01
²³¹ Pa	NL	1.4 E-04	3.0 E-02	1.09 E+00	2.73 E-02
²³² Th	NL	1.1 E-04	2.3 E-02	8.57 E-01	2.14 E-02

Table B-2. (continued).

Isotope	Mobile Radionuclide Reporting Limit (Ci/m ³)	Category 1 Waste Limit (Ci/m ³)	Category 3 Waste Limit (Ci/m ³)	ISB Noncombustible Waste Limit ^a (Ci/m ³)	ISB Combustible Waste Limit ^b (Ci/m ³)
Total U	1.4 E-05	NL	NL	NL	NL
²³² U	See Total U	4.6 E-04	4.6 E+00	5.45 E+00	1.36 E-01
²³³ U	See Total U	7.4 E-03	9.7 E-01	2.67 E+01	6.67 E-01
²³⁴ Th	NL	NL	NL	1.00 E+05	2.50 E+03
²³⁴ U	See Total U	8.9 E-03	1.9 E+00	2.73 E+01	6.82 E-01
²³⁵ U	See Total U	2.8 E-03	5.0 E-01	2.93 E+01	7.32 E-01
²³⁶ Pu	NL	NL	NL	1.40 E+01	3.49 E-01
²³⁶ U	See Total U	9.5 E-03	2.0 E+00	2.86 E+01	7.14 E-01
²³⁷ Np ^d	1.1 E-05	6.8 E-04	1.5 E-01	2.55 E+00	6.38 E-02
²³⁸ Pu ^d	NL	4.7 E-03	2.4 E+01	5.22 E+00	1.30 E-01
²³⁸ U	See Total U	5.7 E-03	1.2 E+00	3.08 E+01	7.69 E-01
²³⁹ Pu ^d	NL	1.9 E-03	4.2 E-01	4.62 E+00	1.15 E-01
²⁴⁰ Pu ^d	NL	1.9 E-03	4.3 E-01	4.62 E+00	1.15 E-01
²⁴¹ Am ^d	NL	2.1 E-03	8.5 E-01	4.44 E+00	1.11 E-01
²⁴¹ Pu	NL	6.4 E-02	2.5 E+01	2.35 E+02	5.88 E+00
^{242m} Am ^d	NL	1.9 E-03	1.6 E+00	4.62 E+00	1.15 E-01
²⁴² Cm	NL	NL	NL	2.03 E+02	5.08 E+00
²⁴² Pu ^d	NL	2.0 E-03	4.3 E-01	5.00 E+00	1.25 E-01
²⁴³ Am ^d	NL	1.0 E-03	2.3 E-01	4.44 E+00	1.11 E-01
²⁴³ Cm ^d	NL	1.8 E-02	3.4 E+02	6.67 E+00	1.67 E-01
²⁴⁴ Cm	NL	1.4 E-01	1.6 E+02	8.57 E+00	2.14 E-01
²⁴⁴ Pu ^d	NL	6.1 E-04	1.3 E-01	5.00 E+00	1.25 E-01
²⁴⁵ Cm ^d	NL	1.3 E-03	2.2 E-01	4.44 E+00	1.11 E-01
²⁴⁶ Cm ^d	NL	1.8 E-03	4.2 E-01	4.29 E+00	1.07 E-01
²⁴⁷ Bk ^d	NL	TBD	TBD	2.98 E+00	7.44 E-02
²⁴⁷ Cm ^d	NL	5.6 E-04	1.2 E-01	4.80 E+00	1.20 E-01
²⁴⁸ Cm ^d	NL	5.1 E-04	1.1 E-01	1.21 E+00	3.03 E-02
²⁴⁹ Cf ^d	NL	TBD	TBD	2.96 E+00	7.41 E-02
²⁵⁰ Cf	NL	TBD	TBD	6.74 E+00	1.69 E-01
²⁵⁰ Cm ^d	NL	TBD	TBD	2.13 E-01	5.33 E-03
²⁵¹ Cf ^d	NL	TBD	TBD	2.91 E+00	7.26 E-02

Table B-2. (continued).

Isotope	Mobile Radionuclide Reporting Limit (Ci/m ³)	Category 1 Waste Limit (Ci/m ³)	Category 3 Waste Limit (Ci/m ³)	ISB Noncombustible Waste Limit ^a (Ci/m ³)	ISB Combustible Waste Limit ^b (Ci/m ³)
²⁵² Cf	NL	NL	NL	1.43 E+01	3.57 E-01
²⁵⁴ Es	NL	NL	NL	5.22 E+01	1.30 E+00

Ci/m³ = curies per cubic meter.
NL = no applicable limit for this isotope.
TBD = a limit is under development.

- a. Noncombustible waste means containerized waste forms that show no evidence of combustion or decomposition on exposure to 538 °C (1,000 °F) for 10 minutes.
- b. The combustible waste limit should be used for containerized waste forms that do not meet the definition of noncombustible waste.
- c. Limit for isotope in activated metal.
- d. TRU isotope (half-life >20 years).